Department of Conservation and Recreation
Division of Water Supply Protection
Bureau of Watershed Management

2003 Watershed Protection Plan Update for the Wachusett Reservoir Watershed

Executive Summary

The Department of Conservation and Recreation, Division of Water Supply Protection, Bureau of Watershed Management (and its predecessor, the Metropolitan District Commission, Division of Watershed Management) has been aggressively implementing and expanding its watershed programs in the Wachusett Reservoir watershed since the initial Watershed Protection Plan was published in 1991. The *2003 Watershed Protection Plan Update for the Wachusett Reservoir Watershed* continues this trend of identifying key issues and setting priorities for the DCR Bureau of Watershed Management.

The Plan Update's scope is to: 1.) Document the recommendations of the 1998 Wachusett Reservoir Watershed Protection Plan Update that have been completed; 2.) Incorporate increased knowledge of the watershed and water quality; 3.) Assess the current "state of the watershed"; 4.) Formally state goals and five-year objectives for each program area; 5.) Establish a schedule of activities for the next five years. The update further advances, rather than replaces, the *1998 Watershed Protection Plan Update for Wachusett Reservoir Watershed*. The 2000 *Watershed Protection Plan Update for Quabbin Reservoir and Ware River Watersheds* remains in effect.

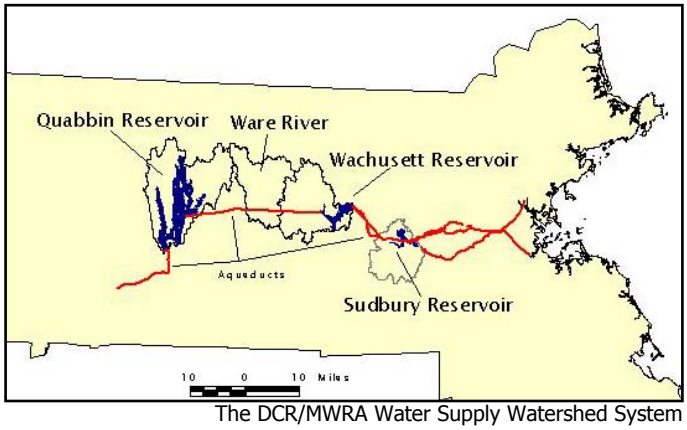
This Executive Summary provides a synopsis of each section of the *2003 Watershed Protection Plan Update for the Wachusett Reservoir Watershed.* The complete *2003 Watershed Protection Plan Update for the Wachusett Reservoir Watershed* is available on the DCR website at www.state.ma.us/dcr.

Introduction

Metropolitan Boston Water System Sources

NOTE: A major reorganization occurred within the Executive Office of Environmental Affairs during the preparation of this plan. Chapter 26 of the Acts of 2003, s. 290 created the new Department of Conservation and Recreation (DCR) by merging the Metropolitan District Commission (MDC) and the Department of Environmental Management (DEM). The responsibilities of the former MDC Division of Watershed Management (MDC/DWM) have been transferred in their entirety to the Bureau of Watershed Management (BWM or "Bureau") within the Division of Water Supply Protection.

The Department of Conservation and Recreation, Division of Water Supply Protection, Bureau of Watershed Management and the Massachusetts Water Resources Authority (MWRA) supply drinking water to 40 communities in the metropolitan Boston area. The Town of Clinton also draws water from Wachusett Reservoir, independent of the MWRA transmission and treatment system. Two communities near Wachusett Reservoir, Worcester and Leominster, may also withdraw water from the system for emergency supply. In addition, three communities west of Quabbin Reservoir obtain their water directly from this reservoir through the Chicopee Valley Aqueduct. MWRA is responsible for treatment and transmission, while BWM is responsible for collection and safe storage of water, protection of reservoir water quality, and management of the watersheds.



The DCR/MWRA Water Supply Watershed System

The Quabbin Reservoir, Ware River, and the Wachusett Reservoir are the active water supply sources for the metropolitan Boston water system. Ware River water is transferred seasonally to Quabbin Reservoir, while Quabbin Reservoir water is transferred regularly to Wachusett Reservoir through the Quabbin Aqueduct. Wachusett Reservoir is the terminal supply reservoir. Water is

withdrawn through the Cosgrove intake at the eastern end of Wachusett Reservoir, and is carried by the Cosgrove Tunnel to the distribution system. The Wachusett Aqueduct provides redundancy to the Cosgrove Tunnel; it was used during the winter of 2003-2004 to allow connections to be made to MWRA's new Walnut Hill Treatment Plant. The Sudbury and Foss (Framingham #3) Reservoirs are the emergency reserve water supplies for this system.

Purpose of Plan Update

MDC and MWRA developed two watershed protection plans (referred to as WPPs or Plans) in 1991: one plan for activities in the Wachusett Reservoir watershed and another plan for activities in the Quabbin Reservoir and Ware River watersheds. These were the first formal written plans to address the comprehensive protection of the water supply watershed system.

Since the original Plans were prepared in 1991, BWM has greatly expanded its watershed protection programs. The 1998 *Watershed Protection Plan Update for the Metropolitan Boston Water System Wachusett Reservoir* (the 1998 Plan) established a new set of objectives for BWM to attain.

Some of the Bureau's significant achievements over the past five years include:

- Utilizing a leading-edge land acquisition model and purchasing thousands of acres of watershed lands.
- Maintaining a successful wildlife control program.
- Updating Public Access and Land Management Plans.
- Sustaining the watershed ranger program.
- Implementing the Watershed Protection Act land use regulations.
- Replacing watershed sanitary surveys with more detailed sub-basin Environmental Quality Assessments.
- Creating wastewater pilot projects.
- Supervising the installation of sewers in the most critically impacted sections of the watershed.
- Developing a community Technical Assistance contract program.
- Sponsoring public education projects.
- Meeting the federal requirement of less than 10% of samples above the 20 cfu/100 ml limit for fecal coliform bacteria.

A Plan update will integrate these measures that have augmented BWM's understanding of potential watershed contamination sources, their influence on intake water quality, and the most feasible and effective control approaches. Another reason for the Plan update is the DCR and MWRA focus on public health and the continued high priority concern of the U.S. Environmental Protection Agency (EPA) and Massachusetts Department of Environmental Protection (DEP) focusing on the threat of *Giardia* and *Cryptosporidium* pathogens. Finally, as a component of the application for a waiver from the Safe Drinking Water Act (SDWA) filtration requirement, MDC/DWM and MWRA were committed to update this Plan on a five-year cycle.

Throughout this past five-year period, the BWM has been refining its strategies to best meet the goals of the Watershed Protection Plan. Several significant management plans have been developed or revised, representing the framework for the agency's approach to water quality protection. This Plan Update unifies the goals and objectives described in the following plans:

- 1998 Land Acquisition Plan
- 2001 Wachusett Land Management Plan
- 2003 Public Access Plan.

The Bureau has also commissioned several studies by expert consultants on a variety of technical topics, including:

- 1999 Stormwater Management, by Camp, Dresser and McKee, Inc.
- 1998 Agriculture, by Comprehensive Environmental, Inc.
- 1998 Highways/Railways Hazardous Material Transportation Release Control Project by Rizzo Associates.
- 1997 Hazardous Materials Emergency Response Plans, by Comprehensive Environmental, Inc.

The Watershed Protection Plan acts as an "umbrella" for all of the Bureau's activities. This document presents the most critical elements of each management plan and study; the individual plans and studies provide substantially more detail on their particular issues.

Regulations and Policies Concerning Watershed Protection Plans

This Plan Update is provides BWM with a focused program of activities for the next five years, reflecting the agency's goals and priorities, and to satisfy DEP and EPA criteria for watershed protection for unfiltered systems. The Plan's content has been organized to address the following regulations and guidelines pertaining to adequate watershed protection (regulatory agency in parenthesis):

- Surface Water Treatment Rule (EPA, DEP)
- Guidance Manual for Compliance with the Filtration and Disinfection Requirement (EPA)
- Policy 89-09 – Watershed Resource Protection Plan Policy (DEP)
- Guidance on the Preparation of a Watershed Resource Protection Plan (DEP)
- Program to Measure Success of Watershed Protection Efforts Conducted by Public Surface Water Supplies to Obtain, and Maintain, a Waiver from Filtration Requirements (DEP)
- "Developing a Local Surface Water Supply Protection Plan" (DEP)
- State Source Water Assessment & Protection Program Guidance (DEP, EPA)
- Interim Enhanced Surface Water Treatment Rule (EPA, DEP)
- Long Term 2 Enhanced Surface Water Treatment Rule (LT2) (EPA).

Filtration Waiver

Throughout the early 1990s, MWRA conducted a series of studies and plans to determine its approach to system treatment. MWRA evaluated both filtration and non-filtration

alternatives to comply with the SDWA regulations. A balanced investment strategy was chosen of watershed protection, improved treatment with ozone, a new distribution tunnel and covered storage facilities, and an extensive program to rehabilitate community water pipes. In October 1998, MWRA and MDC/DWM submitted an application for a waiver from the filtration requirement for the Wachusett Reservoir.

After a hearing and comment period, DEP agreed in December 1998 with MWRA's approach and determined that filtration was not required for the DCR/MWRA system. EPA, however, did not agree and continued to prosecute the enforcement action previously filed under its SDWA "overfiling" rights, seeking to require MWRA to build a filtration plant, contending that the SDWA allowed no other option.

After two months of testimony, the U.S. District Court ultimately concluded that the comprehensive strategy to improve drinking water proposed by MWRA and MDC/DWM, through watershed protection for Wachusett and Quabbin reservoirs, a new ozonation/chloramination disinfection facility, and a community pipe rehabilitation program, sufficiently protects the public health and cost-effectively improves drinking water quality.

Watershed Assessment

Planning for management and control of a watershed must begin with an understanding of the natural processes and human development characteristics that influence water flows and quality. The 1998 Plan, along with recent Environmental Quality Assessment Reports, contain useful information on natural characteristics, land use and development, hydrology, and water quality addressed at the subbasin level.

Natural Characteristics

Key points on the natural characteristics of the watershed include:

- The topography of the watershed is mainly hilly, encompassing flatter wetlands and flood plains, as well as some mountainous terrain with exposed bedrock.
- Watershed geology features glacial till deposits on uplands and glacial outwash deposits on lowlands and valleys.
- Soils have low to moderate erosion potential, and because the watershed is heavily forested and generally lacks steep slopes, the extent of erosion prone areas is limited.
- Soils are generally not well suited for the disposal of wastewater through septic tanks, but strict Title 5 regulations set in place in 1995 are expected to prevent newer septic tanks from posing a threat to groundwater quality and to gradually replace or upgrade older substandard tanks.
- Most of the watershed land is forested, and a large portion of the forested area is owned by the BWM or otherwise protected.
- BWM has subdivided the Wachusett Reservoir watershed into 49 smaller subbasins and uses these to organize and track watershed protection programs, identify problems, and implement solutions.

Land Use and Protection

Land use and development patterns in a watershed also influence the hydrology and water quality of its streams and lakes/reservoirs, and are important considerations to determine the appropriate protection measures for the watershed. Land use and population density statistics for the Wachusett Reservoir watershed (excluding the reservoir itself) are:

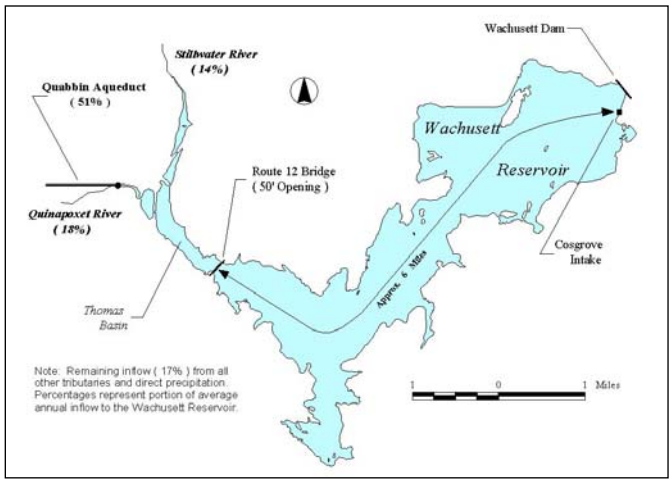
Land Use Category	Percent of Watershed
Forest	63.0%
Wetland	6.8%
Agriculture	7.2%
Residential	8.2%
Commercial/ Industrial	0.6%
Open Water	8.0%
Other	6.2%
Persons/ sq. mi.	253

Source: MassGIS, 1999; U.S. Census, 2002

Overall, the BWM owns and/or controls about 29% of the Wachusett Reservoir watershed, exclusive of the reservoirs themselves. The Wachusett Reservoir surface area, when full, has a surface area of 4,122 acres, representing 5.5% of the entire watershed area. Other state agencies, non-profit land conservation organizations, and municipalities own and protect another 14% of the watershed. Private property enrolled in the Chapter 61 tax abatement program, which helps foster private forestry, agriculture and recreation but is not a permanent form of protection, accounts for 10% of the watershed area. An additional 17.4% of the most sensitive areas in the Wachusett Reservoir watershed are jurisdictional under the Watershed Protection Act (WsPA); while these lands are still able to be developed, the BWM has the ability to review and minimize the impact of proposed projects located within these critical resource areas.

Hydrology

Wachusett Reservoir receives more than 50% of its annual inflow from the Quabbin Reservoir. Inflows from Wachusett Reservoir's two main tributaries account for another 30% of its annual inflow. The elongated shape, large size and depth of Wachusett Reservoir results in long detention times, and significant dilution and settling of



Major Inflows to Wachusett Reservoir

tributary inflows. Almost 90% of the total annual inflow to Wachusett Reservoir enters the reservoir at or above Thomas Basin, a narrow basin reservoir bounded on its lower end by the Route 12 bridge.

The reservoir is subject to seasonal effects, mixing completely between the late fall and spring, and developing complete ice cover during most winters. The reservoir becomes thermally stratified in the summer as is typical of most deep temperate water bodies. Streamflow in the Wachusett Reservoir watershed has significant seasonal changes. Flows tend to be highest in the spring, due to snowmelt and high groundwater; and lower in the summer and early fall. Streamflow also varies in response to rainfall events, being several times higher than baseflow during storms.

Water Quality

Reservoir

Wachusett Reservoir has crystalline water with low turbidity, bacterial counts, plankton densities, and nutrients. The reservoir has met SWTR source water quality criterion for unfiltered systems since July 1993. The detection of *Giardia* and *Cryptosporidium* at the reservoir intake and at Wachusett Reservoir's other sampling locations has been very low. More than 96% of total samples have been below the detection limit for *Giardia* and *Cryptosporidium* since March 1995.

Major findings of nutrient and plankton monitoring conducted since 1998 include marked seasonal and vertical variations in nutrient concentrations mediated by phytoplankton dynamics, shifts in nutrient concentrations and the intensities of other parameters corresponding to the timing and magnitude of the annual water transfer from Quabbin Reservoir, and an annual cycle of phytoplankton succession and abundance characteristic of many temperate, oligotrophic systems. The macrophyte flora of Wachusett Reservoir has been characterized. The alien species posing the greatest potential threat to water quality is Eurasian Water-milfoil (*Myriophyllum spicatum*) and it has been the focus of intensive control efforts since 2002.

Tributaries

Wachusett Reservoir tributaries for the most part have clear water with low bacterial counts and nutrient levels. Biomonitoring of insect populations has shown that the biota present are generally indicative of healthy ecosystems and intolerant of pollution. Turbidity and fecal coliform bacteria in the tributaries fluctuate in response to storm flows and other conditions. Wachusett tributary fecal coliform bacteria spikes can affect the upper ends of the reservoirs, but do not impact water quality near the reservoir intake.

In the Wachusett Reservoir, 90% of tributary inflows enter the reservoir at Thomas Basin, which through sedimentation and the long travel time to the intake allows bacteria to die off or disperse in surrounding waters. While the overall detection of *Giardia* and *Cryptosporidium* in the Wachusett Reservoir watershed was higher than at the intake, it is considered relatively low, especially because some watershed sample stations have been deliberately located in problematic rather than typical areas of the watershed. The lower pathogen incidence at the intake locations suggests that there may be attenuation of pathogen levels through in-reservoir processes such as dilution, settling, predation or die-off. Some tributaries in the Wachusett Reservoir watershed have elevated nitrate levels, but these tributaries are small and only contribute a minor portion of the total annual nitrate load to the reservoir. Phosphorus levels in the tributaries are very low.

Watershed Protection Goals

The Bureau of Watershed Management within the Division of Water Supply Protection of the Department of Conservation and Recreation, a state agency within the Executive Office of Environmental Affairs, has been charged by Chapter 26 of the Acts of 2003, s. 290 with protection of the Wachusett Reservoir watershed. The Bureau continues a century of MDC management. The MDC Division of Watershed Management was established when Chapter 372 of the Acts of 1984 divided the former MDC Water Division into the DWM, responsible for watershed operation and management, and the new Waterworks Division of the MWRA, responsible for transmission and treatment. BWM is a single-purpose, watershed-focused unit of DCR.

The BWM inherits the mission derived from the MDC Division of Watershed Management's enabling legislation and subsequent amendments, found at MGL c. 92, § 104 – 120. The statute directs the BWM to:

> ...construct, maintain and operate a system of watersheds, reservoirs, water rights and rights in sources of water supply [to] supply thereby a sufficient supply of pure water to the Massachusetts Water Resources Authority, and [to] utilize and conserve said water and other natural resources to protect, preserve and enhance the environment of the Commonwealth and to assure the availability of pure water for future generations.

The body of legislation makes directives on specific management aspects of the watersheds, authorizing BWM to:

- Have the exclusive right and control over all ponds, reservoirs, and other property within the watershed system, and [may] order all persons to keep from entering in, upon or over the waters thereof and the lands of the commonwealth or towns surrounding same.
- Make rules and regulations for the protection of the watersheds.
- Establish the Quabbin Watershed Advisory Committee, the Watershed System Advisory Committee (covering Wachusett and Sudbury watersheds), and the Ware River Watershed Advisory Committee.
- Adopt periodic watershed management plans to provide for forestry, water yield, and public access among other purposes.

Building on the legislative-defined mission, BWM's charge today has evolved. The goals of the Bureau are:

- To maintain and operate the source facilities (including dams) safely and efficiently.
- To preserve and improve water quality of the supply sources, through regulation, direct action, and cooperation, as needed to protect public health and to meet state and federal water quality standards.

- To fulfill the watershed protection and management requirements associated with drinking water regulations.
- To implement the specific directives of the legislature, such as providing recreation opportunities balanced with the protection of the water supply sources and promulgating and enforcing rules and regulations for BWM lands and for protected zones.
- To involve watershed towns, residents, and the public in appropriate ways in the conduct of the BWM's watershed management functions.

In addition, BWM has defined water quality goals for the system:

Primary Goals
- To prevent waterborne disease.
- To maintain a high quality source water.
- To meet the source water coliform criterion.

Secondary Goals
- To reduce/control nutrient inputs to the reservoir.
- To reduce risk of a chemical hazardous material spill.
- To control general pollutant transport into the reservoir.

Framework for Programs

BWM and MWRA are committed to a strong watershed protection program for the Quabbin/Ware/Wachusett water supply system. BWM has adopted a three-tiered approach to watershed protection:

1. Protect the most sensitive areas through ownership or agreements with land owners.
2. Correct existing sources that could cause or have caused contamination of any waters in the system.
3. Work with watershed communities to protect resources while accommodating local needs.

Over time, existing problems will be eliminated and watershed programs will focus on prevention and maintenance. BWM and MWRA believe that this watershed management system provides a drinking water source of exceptionally high quality, and have developed a comprehensive program to ensure that this level of quality will be maintained and enhanced.

Assessment of Threats

The 1998 Plan included identification of potential sources of contamination, and ranking of these threats as High, Medium, or Low priority. These threat priorities were based on the best available information at the time, including knowledge of the land use or activity, federal and state environmental permit records, files from local town boards, land use data, and available maps. With BWM's greater knowledge of watershed activities, reservoir hydrodynamics, and water quality, and in the context of defined water quality goals, it is appropriate to revisit the activities and rankings identified in previous plans.

While BWM and MWRA remain committed to reducing all potential contaminants in the reservoir, drinking water industry research clearly indicates that control of pathogens must be a top concern. Therefore, activities involving potential exposure to human or animal wastes are high priority for control. Conversely, some types of pollution threats (such as underground fuel storage tanks) are highly regulated by DEP and typically pose a low level risk to surface waters, and are a particularly low threat in the Wachusett Reservoir watershed.

The following table presents the threat priorities established by the 2003 Plan. Most assessments have remained the same as those set by the 1998 Plan. The few modifications that have occurred were made after careful consideration of conditions in the Wachusett Reservoir watershed combined with the status of the watershed protection program.

Potential Source of Contamination	2003 THREAT
Wildlife – Birds	High
Wildlife – Aquatic Mammals	High
Stormwater	Medium
Highways and Railways – Uncontrolled Releases	High (Potential)
On-site septic systems (*Once sewers complete)*	High *(Medium)*
Erosion	Medium
Local Land Uses – Construction	Medium
Local Land Uses – Future Development	Medium
Public Access	Medium
Agriculture – Chemicals	Low[1]
Agriculture – Livestock & Crops	Low[1]
Gas/Petroleum Storage	Low
Highways and Railways – Road Salting	Low
Highways and Railways – Herbicide Use	Low[2]
Local Land Uses – Gravel Mining	Low
Permitted Activities – Solid Waste Facilities	Low
Permitted Activities – NPDES/Groundwater Dischargers	Low
Permitted Activities – Hazardous Waste Generators	Low
Private Forestry	Low
Unauthorized Activities	Low
Uncontrolled releases – Fixed Site	Low

[1] Based on evaluations done over the past five years, including water quality sampling and analysis, environmental quality assessments, studies by the University of Massachusetts, and the reduction in the number of active farms, MDC has re-assigned these risks from Medium to Low.

[2] Reduction of threat based upon pending adoption of revisions to 333 CMR 11.00.

Resource Protection

Protecting natural resources – both land and water ecosystems – is a crucial element to watershed management. BWM has successfully developed and implemented three significant plans that minimize impacts to water quality. *The Land Acquisition Plan*, originally written in 1991 and revised in 1998, sets the goals for the Bureau's land purchases. *The Wachusett Reservoir Watershed Public Access Plan*, a 1996 document updated in 2003, details policies for public use of BWM property in the watershed. *The Wachusett Reservoir Land Management Plan*, published in 2001, describes how the BWM manages the natural resources on its watershed land.

Wildlife control, in particular the harassment of gulls and other water-based birds, is a critical element to the Bureau's success at maintaining the water quality parameters necessary for an unfiltered drinking water supply. BWM also relies on other owners of conservation land, both public and private, to help meet its water quality goals.

Land Acquisition

Goal: To provide long-term water quality protection through the acquisition of rights to sensitive watershed lands, allowing the establishment of stable forest cover and reduction of potential development.

BWM acquired 3,415 acres over the past five years bringing the total acreage now held both in fee and Conservation Restriction (CR) to 18,438 acres. The total amount of land under BWM control is 20,602 acres after the inclusion of the property held by DCR/Division of State Parks and Recreation that is under a Care and Control Agreement with the Bureau. Each land acquisition goal has been reached or is ahead of schedule, including 25% ownership target established by EPA and internal benchmarks established by the 1998 MDC Land Acquisition Plan. Future land acquisition efforts will continue where needed to protect highly sensitive land from development.

Public Access

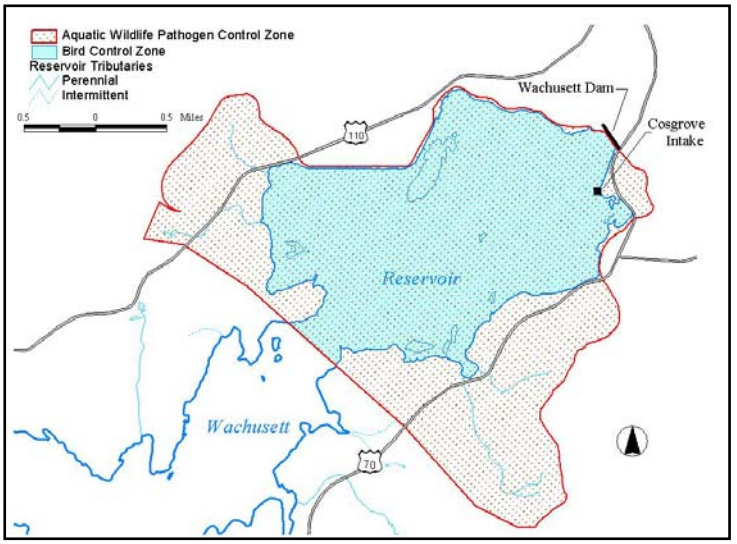
Goals: 1.) To minimize the threat to water quality from public use of BWM watershed lands. 2.) To gain community understanding and support for the BWM's public access policies. 3.) To attain compliance with and enforce BWM Public Access regulations. 4.) To assess, and revise if needed, current access policies.

BWM has an established effective and comprehensive program of control over recreational and unauthorized use of its facilities. This program is based on no-access protective zones around water supply intakes, the presence of an active ranger force, and the control of permitted activities. This restrictive public access policy is aimed at preventing the introduction of microbiological pathogens and monitoring security.

Wildlife Control

Goal: To prevent elevated fecal coliform bacteria and other pathogen levels at the Cosgrove intake through appropriate wildlife controls.

The Bird Harassment Program and other wildlife controls are key pieces to the Bureau's success at maintaining low fecal coliform bacteria counts in the Wachusett Reservoir. The period from February 1999 to December 2003 has been the longest stretch of time since the promulgation of the Surface Water Treatment Rule in 1989 that there have been no exceedances of the SWTR's Fecal Coliform Bacteria criteria at Wachusett Reservoir. The impact of birds on the intake water quality continues to be significantly diminished due to the harassment program and related efforts. Aquatic mammals are a potential concern, but are being controlled in critical areas; there is no evidence of pathogen contamination from these animals reaching the intake.



Bird and Wildlife Pathogen Control Zones

Reduction of bird numbers within the Bird Control Zone at the north end of the reservoir should be sufficient to reduce impacts from fecal coliform bacteria at the intake. Control of beavers and muskrat within the Pathogen Control Zone will also protect water quality and infrastructure. Observation, harassment, and removal activities should be utilized year round and modified as necessary to provide adequate protection for the metropolitan Boston drinking water supply.

Land Management

Goals: 1.) To follow the land management guidelines that are outlined in the Wachusett Reservoir Watershed Land Management Plan. 2.) To continue to conduct all silvicultural activities and other management strategies with the ultimate goal of water quality protection. 3.) To assess all newly purchased lands and plan accordingly in order to manage them in the best way possible.

The majority of the Wachusett Reservoir watershed forest is over 70 years old. It originates from plantation establishment during the first half of the century and from natural regrowth. The 16,384 acres of BWM-owned forests and fields provide a significant level of long-term water quality protection to Wachusett Reservoir. The successful Land Acquisition program has provided BWM with many new parcels, all of which require assessment, analysis, and management. A process has been initiated to ensure that land management work is prioritized based on water quality, emergency access and security issues.

Although most BWM-owned land in the Wachusett Reservoir watershed is forested, the number of non-forested BWM properties has also increased; there is an ongoing need for coordinated management of these fields, lawn and shoreline areas. The *2001-2010 MDC/DWM Wachusett Reservoir Watershed Land Management Plan* describes bureau staff activities on DCR lands in greater detail.

Other Protected Lands

Goals: 1.) To maximize the water quality protection provided by non-BWM conservation land. 2.) To establish the Bureau's CR program as a model for other agencies programs.

In addition to the 20,600 acres owned or controlled through agreement by BWM, 9,590 acres are in protective ownership by EOEA agencies, towns, and private non-profit agencies. The Chapter 61 tax abatement program also provides a limited degree of protection to the 7,042 acres of enrolled privately owned lands.

The Bureau's approach to maximize its land acquisition funds by purchasing Conservation Restrictions has made it a leading holder of these easements in the Commonwealth. While not providing as complete control as fee purchases, CRs are a significant resource protection strategy. The Bureau monitors each CR on an annual basis and works with the landowners to resolve any compliance issues with the language of the easement.

Monitoring Programs

Monitoring the health of the watershed is at the core of the Bureau of Watershed Management's efforts to provide a clean water supply. Water quality sampling and field inspections help ensure compliance with state and federal water quality criteria for public drinking water supply sources. The Bureau also samples to better understand the responses of the reservoir and its tributaries to a variety of physical, chemical, and biological inputs, and to assess the ecological health of the reservoir and the watershed.

BWM staff utilize state-of-the art techniques to test the water in the reservoir and its tributaries. Development impacts are closely monitored and mitigated through the Watershed Protection Act; the Bureau also relies on other state, local and federal laws to minimize the impacts of human activity. Environmental Quality Assessments (EQAs) are performed on sub-watersheds in a five-year cycle in order to identify potential water quality problems, seek out the source of the problem, and identify options for remediation.

Water Quality Monitoring

Goals: 1.) To perform water quality sampling in order to help ensure compliance with state and federal water quality criteria for public drinking water supply sources. 2.) To better understand the responses of the tributaries and reservoir to a variety of physical, chemical, and biological inputs, and to assess the ecological health of the watershed.

Water quality sampling and watershed monitoring make up an important part of the overall mission of the Bureau. Water quality sampling and field inspections help identify tributaries with water quality problems, aid in the implementation of the Bureau's watershed protection plan, and ensure compliance with state and federal water quality criteria for public drinking water supply sources. Bacterial monitoring of tributaries provides an indication of sanitary quality and helps to protect public health. The Bureau also samples to better understand the responses of the tributaries to a variety of physical, chemical, and biological inputs, and to assess the ecological health of the watershed.

Water quality in the tributaries over the past five years has remained relatively unchanged, although some significant improvements were recently detected in Gates Brook following the completion of a municipal sewerage system in the area. Most tributaries had annual median fecal coliform bacteria concentrations similar to those recorded over the previous ten years. A few showed minor water quality improvements; none exhibited a decline in water quality.

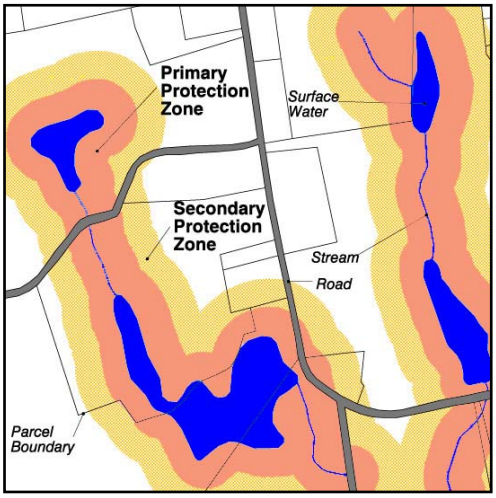
Further refinement of specific methods will enable the utilization of alternative indicators such as *E. coli*, *enteroccocus*, Bifidobacteria, *Rhodococcus coprophilus*, and *F specific RNA coliphag*e to better understand water quality and to prepare for changing EPA standards. The Bureau will also continue with routine monitoring, stormwater sampling, and macroinvertebrate collection to provide a complete understanding of watershed water quality

Water quality in Wachusett Reservoir remains very high, with only minor taste and odor episodes due to plankton and no exceedences of federal or state drinking water standards for fecal coliform bacteria since March of 1999.

Watershed Protection Act

Goals: 1.) To prevent impacts to water quality from development in the most critical areas of the BWM water supply watersheds. 2.) To provide fair and consistent interpretation of the WsPA regulations and timely review and decision making on property applications. 3.) To utilize the regulations to educate land owners and town officials about the effects of development on water quality and ways to mitigate these impacts.

The Watershed Protection Act (WsPA) is a law passed in 1992 by the Commonwealth (St. 1992, c. 36). This legislation – also known as the "Cohen Bill" after its initial sponsor – created regulations, 350 CMR 11.00, that established a "comprehensive scheme to regulate land use and activities within certain critical areas" of the Quabbin Reservoir, Wachusett Reservoir, and Ware River watersheds.



Watershed Protection Act Zones Illustration

Many aspects of the use and development of land affect the quality of nearby streams which then flow into reservoirs and other sources of water supply. Type of development, density, amount of paved surface, and proximity to river banks are contributing factors to the amount and types of pollutants that can end up in a stream. Some of the strategies used by the WsPA to minimize the effects of human activities on water quality include: preserving a buffer zone

along the water resources, limiting impervious surfaces, and restricting the storage and use of hazardous materials.

Watershed Protection Act review has resulted in more sensitive land development. Some projects have been relocated further away from resource areas. Other construction resulted in less dense development of the land or implementation of additional mitigation measures. BWM staff continue to implement the Act as well as reviewing development projects outside of priority resource areas, promoting watershed-wide resource protection.

Watershed Protection and Other Environmental Regulations

Goals: 1.) To work cooperatively with appropriate agencies towards maximum feasible compliance with all environmental regulations. 2.) To be consistent in application and interpretation of regulations.

There is a broad array of federal, state, and local laws and regulations that act as a significant control against potentially polluting activities on private lands throughout the Wachusett Reservoir watershed. While implemented by other entities, BWM staff presence in the watershed can enhance the administration and enforcement of these laws, resulting in a higher rate of compliance. Control of regulated sites and activities through these regulations has minimized the threat these sites pose to water quality.

Environmental Quality Assessments

Goals: 1.) To provide a comprehensive inventory of resources as well as an overview of existing and potential threats to the water supply. 2.) To provide a framework for prioritization of remediation and protection activities within the watershed.

The Wachusett Reservoir watershed was reorganized by BWM staff in 1998 into five sanitary districts: Reservoir, Thomas Basin, Quinapoxet, Stillwater, and Worcester. A detailed approach to inventory and assess each district at the subbasin level, called Environmental Quality Assessments (EQA), was adopted by BWM. The details provided by the Bureau's EQAs help identify water quality problems, link those problems to the sources of contamination, and develop specific, prioritized goals for corrective actions. EQAs provide a tool to track the impacts of septic systems on a sub-watershed basis.

Pollution Control

The Wachusett Reservoir watershed does not have "point" sources of pollution; i.e., there are no industrial or municipal pipes discharging effluent into any of the reservoir's tributaries. The remaining sources of potential pollution fall into the "non-point source" category. These threats do not emanate from a single location, but are present from various land uses and activities throughout the watershed.

The treatment of wastewater, whether by on-site septic systems or carried off-site through a sewerage system, is a critical component to water quality health. Significant resources have been expended to successfully control this pollution threat. The conveyance of a broader range of potential pollutants via stormwater has subsequently become a higher priority for the Bureau. On-going efforts remain to address site specific threats from transportation and hazardous materials. While agriculture and silviculture are still actively practiced in the watershed, these occupations are not nearly as prevalent as in the past; the Bureau has developed several approaches to minimize the impacts of these diminishing land uses.

Wastewater Disposal

On-site wastewater disposal systems have been considered by BWM for many years to be the most significant potential source of pathogens and other pollutants of concern within the Wachusett Reservoir watershed. Wastewater was targeted as a top priority at the time of the Division's formation in 1985 when the majority of the watershed was served by on-site systems. Many areas within the watershed had significant problems with failing on-site systems, and very limited repair options due to physical constraints. MDC began to take an active role in both on-site system and sewering issues. A Facilities Plan was completed in 1995 for West Boylston and Holden that described a plan to bring sewers to those areas of the communities where system repairs were not feasible. The Facilities Plan also contained recommendations for areas that would continue to be served by on-site wastewater disposal systems.

The MDC program specifically targeted sewers for sensitive areas that were most impacted by failing on-site systems, had significant physical constraints limiting repairs, and where water resources were potentially impacted by failing systems. The sewage flows to the Upper Blackstone Water Pollution Abatement District, which discharges the treated effluent outside of the watershed. With the completion of the sewer project in 2004, 11,000 persons, or 40% of the watershed residents, will have an available sewer system. The remaining 60% of the watershed, or approximately 17,000 persons, will utilize on-site systems.

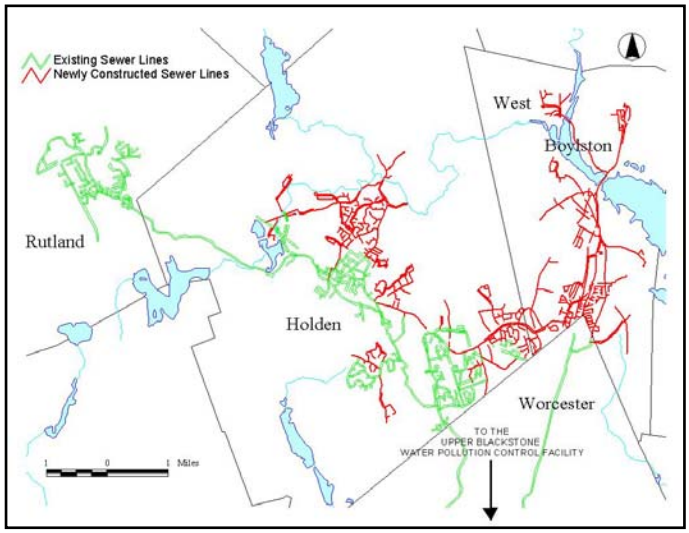
Sewers

Goals: 1.) To protect existing high-quality water resources from degradation due to wastewater disposal in the watershed system. 2.) To minimize through education and outreach the potential impacts of wastewater disposal on the waters of the watershed system.

BWM has spent considerable effort to bring sewers to the areas of the watershed that were severely septic polluted. The completion of the Wastewater Facilities Plan for the Towns of Holden and West Boylston, and the approval of a funding program totaling $78 million, is a very significant accomplishment. The new sewer system coverage in Holden and West Boylston coincides with subwatersheds most severely impacted by on-site wastewater disposal based on BWM's septic severity rating system stream classifications.

Approximately 2,200 watershed residents in Holden and Rutland already are connected to sewers built by MDC in the 1930s. Based on the on-going sewer system expansion in Holden and West Boylston, the majority of which will be completed in 2004, an additional 3,600 lots will connect to sewers. The Bureau will track the hook-ups to the sewers in

order to help maximize the number of homes within the service areas that are connected to the sewers as they become available.



Sewered Areas of the Wachusett Reservoir Watershed

On-site Treatment

Goal: To protect water resources from degradation due to on-site wastewater disposal in the watershed.

There are currently an estimated 10,200 on-site systems serving an unsewered population of about 28,000 within the Wachusett Reservoir watershed. After completion of the municipal sewer systems currently under construction, approximately 60% of watershed residents will remain served by an estimated 6,600 on-site systems. The completion of the sewer project will enable BWM to focus wastewater efforts on the remaining moderately impacted acres and the areas less impacted by wastewater.

On-site wastewater disposal can be an accepted method of wastewater disposal in a water supply watershed, provided that such systems are designed, operated, and maintained in compliance with the Title 5 requirements, and that water quality is not impaired. Within those portions of the watershed expected to continue using on-site systems, there are a few individual lot and isolated neighborhood trouble spots. The BWM will address any potential problems on a case-by-case basis with the local boards of health.

Stormwater Management

Goals: 1.) To enhance the water quality reaching the reservoir through BWM-owned property. 2.) To assist local and state officials in taking responsibility for improving quality of local stormwater runoff.

BWM has made significant progress dealing with a number of specific water quality threats, such as failing septic systems, potential releases of hazardous materials, and wildlife. As a result, stormwater, which can be considered a general category that encompasses all land-use generated pollutants, has become a high staff priority. Federal NPDES Phase II stormwater requirements have been established since the 1998 Plan was developed, and will provide an opportunity for a coordinated approach to address stormwater impacts.

The Bureau has developed a three tier approach to managing stormwater concerns focusing on protection, remediation, and prevention. The stormwater control work that has been conducted has demonstrated that effective, fiscally responsible initiatives must be implemented for specific pollutants that are causing documented problems within the reservoir. Successful implementation should focus on the following elements: public education, local coordination and technical assistance; studies and investigations; and the design and installation of structural BMPs on BWM owned lands.

Transportation and Hazardous Materials

The Wachusett Reservoir watershed is not a remote or isolated area. Thousands of people live in the watershed; roads and railroads traverse the region and are significant watershed features. The impacts from daily transportation activities on water quality must be managed by BWM. The Bureau must be prepared to respond to accidents that might release hazardous materials or other pollutants into the reservoir. In light of heightened security concerns, BWM must also consider the possibility of deliberate releases and develop preparedness plans.

Highways and Railroads

Goals: 1.) To make improvements in the safety of the transportation corridors by structural and operational enhancements, minimizing the threat from accidental releases. 2.) To improve existing drainage infrastructure to minimize pollutants that are discharged with stormwater to the reservoir or its tributaries.

Transportation related runoff is a moderate threat, though spill/releases are a high potential threat. The most significant pollutants in runoff are heavy metals and petroleum products; less significant pollutants are sediments and pesticides/ herbicides. Sodium from roadway salt was determined to be a necessary application to reduce the risk of accidents along the roadways.

BWM has built upon a 1998 *Transportation Release Controls Study*, working with local communities, Massachusetts Highway Department and rail carriers on improving drainage infrastructure so that pollutants are removed from stormwater prior to discharge to the reservoir or its tributaries. The drinking water and transportation agencies gain mutual benefits by increasing the safety of highway and railway corridors, which in turn minimize the opportunity for accidental spills.

Hazardous Materials Emergency Planning and Response

Goals: 1.) To ensure prompt, effective response actions to accidental spills or releases of hazardous materials. 2.) To reduce the volume of hazardous materials in the watershed.

The level of threat from an accident involving hazardous materials depends on the type and volume of the product released, the location of the incident, and weather conditions. The most critical areas are within and adjacent to the reservoir, which also have the highest volume of hazardous material transportation.

BWM has made considerable progress in augmenting the resources available to the region's first responders. Ongoing planning, communication, and training exercises will further complement the preparedness of all those who are responsible for emergency response in the watershed.

Other Pollution Sources

The 1991 Plan identified a variety of potential sources of contamination and prioritized their threat level. Many of these potential sources were ranked low, or were subsequently reduced to a low priority by the 1998 Plan Update due to the control programs in place. The Bureau's monitoring programs provide many of the measures necessary to control the following sources of pollution: Gas/Petroleum Storage, Road Salting, Gravel Mining, Solid Waste Facilities, Groundwater Discharges, Hazardous Waste Generators, and Uncontrolled Releases from Fixed Sites.

The following three sections describe the few remaining land uses that are either a medium priority, have been reduced to a low priority by the Bureau, or have consistently maintained a low priority but nevertheless require staff resources.

Construction (Erosion and Sediment Control)

Goal: To minimize erosion and sedimentation from active construction sites in the Wachusett Reservoir watershed.

Erosion of sediment into watershed resource areas can cause serious environmental problems. Erosion from construction sites results in loss of resource areas and is harmful to wildlife. BWM staff work diligently to minimize erosion by reviewing sites prior to the start of construction.

Problems often arise because proponents do not follow the erosion and sediment controls agreed to when the site plan was reviewed. Although some property owners are cooperative, the threat of enforcement is sometimes needed to ensure that corrective actions are taken. If problems occur on a site that is subject to the Watershed Protection Act, BWM can take direct action based on these regulations. If problems occur on a site that is not subject to the WsPA, BWM will coordinate with the conservation commission, asking them to take the lead on enforcement. If the conservation commission is not able or does not want to take enforcement action, BWM can proceed using 350 CMR 11.09, the general watershed protection regulations.

Agriculture

Goal: To minimize the potential for agricultural wastes and chemicals to leave the source and to enter tributary waters of the reservoir, focusing first on pathogens.

Many watershed residents consider farming a community resource which is an important component of community character, as well as a help to preserve open space. As much as it is a cherished part of the landscape, farming can have negative impacts on water quality. BWM's goal is not to eliminate agriculture but to control the greatest threat to water supply posed by these activities, which is contamination from animal wastes containing pathogens. Assessment of actual risk is very complicated due to the many unknowns about transport, fate, viability, infectivity, dosage, problems with existing testing methods, and other factors which must be considered to evaluate actual risk posed by livestock. Other pollutants, including nutrients, pesticides, and suspended solids, may be generated by livestock, crop production and nursery/landscape operations. These compounds all pose a potential threat to water quality, but are considered a lesser health risk than pathogens. Overall, however, agriculture that is properly conducted should pose a very limited risk to water supply.

The majority of farms in the Wachusett Reservoir watershed are small-scale operations. Few farms have more than 100 animals; many can be considered "hobby farms" or "gentleman farms." It is also important to note that most of the larger farms are located in the Worcester sub-watershed, which is the area most remote hydrologically from the reservoir.

The 1998 Plan focused on potential pathogen contamination and placed agriculture on a higher level of concern than in the 1991 Plan. BWM dedicated significant resources to working with farmers and federal and state agricultural agencies to correct water quality problems related to agricultural practices. BWM has also developed and implemented a policy for working with land owners to correct water quality problems caused by agricultural operations. Due to these efforts, combined with the continuing decline of farm and agricultural operations, agriculture has been reduced to a low priority threat.

Private Forestry

Goal: To encourage owners of privately held forested land to practice sound forest management.

Providing technical and monetary assistance to individual landowners is an effective way to obtain additional measures of protection from silvicultural activities on private land. Encouraging appropriate and sound forest management on private land reduces the likelihood of development and promotes a diverse forest cover.

Thirty four Forest Management Plans, totaling 2,115 acres, have been funded on the Wachusett Reservoir watershed. These management plans provide additional measures of watershed protection from silvicultural activities on private land. The Chapter 61 program, which provides tax benefits to owners of forested or agricultural lands who register their property, is also an important conservation tool.

Infrastructure

The DCR/MWRA Drinking Water Supply System is an engineering marvel. Starting with cisterns in colonial Boston, the system has grown to encompass lands and water over 100 miles to the west. The BWM Watershed System (Wachusett Reservoir, Quabbin Reservoir, Ware River and Sudbury Reservoir (the emergency supply)) delivers 250 million gallons of day to the MWRA to distribute through its transmission distribution system to 43 communities.

Continual inspections, maintenance and improvements are required in order to provide the consumer with clean, safe drinking water. The events of September 11, 2001 have raised additional security concerns which both agencies have addressed in their facility management. The MWRA and the BWM are completing a significant phase of infrastructure improvements, ensuring pure water for generations to come.

BWM Facilities

Goal: To maintain the watershed infrastructure to ensure public safety, water quality and water supply.

Much of the infrastructure in the Wachusett Reservoir watershed is approaching 100 years in age. Maintenance of these facilities is crucial to the ongoing delivery of pure water to metropolitan Boston. The ongoing program of Dam Safety will make planned improvements to the Wachusett Spillway and North Dike, as well as the installation of special monitoring devices, such as piezometers, inclinometers, and wire strain gages. Due to the close relationship of the various facilities managed by the BWM and the MWRA, it is important that the two agencies effectively communicate on their different construction projects and revisions to the Emergency Action Plan in order to ensure that there are minimal impacts to water quality.

Security

Goal: To provide a safe and secure water supply system.

The security of the metropolitan water system is of great importance. Since the terrorist attacks of September 11, 2001 a number of new operational policies have been enacted. Security of the water system must be comprehensive – source to tap – but flexible enough to adjust to a range of potential threat conditions.

Support Programs

There are several support programs that enable the core elements of Resource Protection, Monitoring, Pollution Control and Infrastructure and enhance their effectiveness. These support programs utilize the Bureau's wealth in both professional staff expertise and natural resources.

Community Technical Assistance

Goal: To improve the watershed protection afforded by local land use control programs.

Most of the specific planning and regulatory tools and techniques that comprise watershed protection (for areas outside direct BWM jurisdiction) must be adopted at the municipal level through town meetings and enforced by local volunteer boards. BWM recognizes the unique "home rule" land use authority vested in Massachusetts municipalities and continues to use its expertise and resources to support local officials' decision making.

Public Education and Community Outreach

Goals: 1.) To foster an attitude of stewardship of the land and water resources of the watershed system among area residents, businesses and visitors. 2.) To promote an understanding of the physical, chemical, and biological properties and functions of surface water, groundwater, wetlands, and aquifers, as well as the relationship between land use and water quality. 3.) To promote widespread knowledge of, and voluntary compliance with, BWM's Rules and Regulations and these rules' public health significance.

BWM has an established program of public education for students, local residents, and visitors on importance of watershed and resource protection. Education is provided in a variety of ways, using direct and indirect contact with individuals and groups. Direct contact includes educational programs through local schools, interpretive programs on BWM properties and education by Watershed Rangers through casual contact with visitors. In addition, staff provide training for teachers in watershed education curriculum through the statewide coordination of ProjectWET. Indirect education occurs through the use of kiosks, bulletin boards and signs, the *Downstream* newsletter and other publications, and the BWM website.

Geographic Information Systems

Goal: To manage a Geographic Information System that provides the necessary data and analyses for the Bureau of Watershed Management to meet its water quality goals and regulatory requirements.

The functions of the GIS Department are an integral part of all the other BWM sections. The maps and analysis produced by the GIS staff provide other Bureau staff with the information necessary to complete their tasks in an accurate and timely manner. In addition, watershed towns and non-profit organizations are able to benefit from this information. The continued expansion, refinement, and effective use of GIS capabilities are integral components of a comprehensive, well-reasoned approach to watershed management.

Research Projects and Special Studies

Goal: To use knowledge obtained from research and special studies to continuously improve watershed management programs and obtain improved water quality.

The protected land holdings of the Wachusett Reservoir watershed are a special environmental system. It is important that the BWM keep abreast of advances in watershed management practice and general environmental science. The agency has established relationships with UMass, Amherst and the U.S. Geological Survey (USGS). Other institutions are also able to request the opportunity to scientifically investigate topics of mutual concern. The Bureau's commitment to watershed and general environmental research projects has furthered watershed protection efforts and staff professional development.

Implementation

The *2003 Watershed Protection Plan Update for the Wachusett Reservoir Watershed* concludes with a five-year Action Plan, containing 113 specific tasks generated from the different sections of the Plan. Each action is prioritized as either "High," "Medium," or "Low," providing the Bureau flexibility to achieve the most critical tasks. BWM will utilize the table as the basis for more detailed annual action plans used for both budgeting purposes and regulatory review.

Personnel costs typically account for over 70% of the operations budget. BWM is committed to the provision of adequate staffing to successfully complete the wide variety of tasks involved in protecting the water supply and providing stewardship over the extensive system of land and water resources under its care and control.

2003 Watershed Protection Plan
Update for the Wachusett Reservoir
Watershed

Department of Conservation and Recreation
Division of Water Supply Protection
Bureau of Watershed Management
251 Causeway St.
Boston, MA 02114

Mitt Romney, Governor
Kerry Healy, Lt. Governor
Ellen Roy Herzfelder, Secretary, EOEA
Katherine F. Abbot, Commissioner

Watershed Protection for the Wachusett Reservoir

Wachusett Reservoir is the terminal supply reservoir of the water supply system operated by the Department of Conservation and Recreation, Division of Water Supply Protection, Bureau of Watershed Management (BWM) and the Massachusetts Water Resources Authority (MWRA). The Wachusett Reservoir watershed is about 74,890 acres in area, including the 4,122 acre reservoir. The BWM owns and/or controls about 29% of the land in the Wachusett Reservoir watershed; other state agencies, non-profit land conservation organizations, and municipalities own and protect another 14% of the watershed.

DCR and MWRA are dedicated to watershed protection as part of a multi-barrier approach to drinking water quality. The Watershed Protection Plan acts as an "umbrella" for all of the Bureau's activities. The first formal written plan to address the comprehensive protection of this water supply watershed system was published in 1991; an initial update was completed in 1998. The *2003 Watershed Protection Plan Update for the Wachusett Reservoir Watershed* considers the implementation of BWM's programs since 1998, integrates the increased knowledge of water quality and watershed sources of concern, and sets a focused watershed protection strategy for the next five years.